Bio-inspired Assembly of Functional Nanomaterials

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Nature adopts a superior approach to nanomaterials assembly in biomineralization processes. We apply the principles derived from biomineralization processes to the assembly of nanoscale functional materials into nanoscale systems. By carefully controlling surface organic molecules to promote heterogeneous nucleation at designated regions while completely suppressing homogeneous nucleation elsewhere, inorganic nanomaterials can be controllably assembled directly from solution. Following this principle, surface carboxylic groups on selective regions were generated on commodity engineering polymers such as polycarbonate (PC) and poly(ethylene teraphthalate) (PET) by direct patterned UV irradiation through a photomask and then were successfully employed to selectively nucleate nanoscale crystalline inorganic materials, such as semiconductors ZnO and CdS, directly from aqueous solutions to form patterned arrays. We have demonstrated such arrays of functional materials in macroelectronic applications. Extending this bio-inspired approach to truly bottom-up nanoscale assembly, we have nucleated arrays of functional nanocrystals (quantum dots) using self-assembled nanostructured block copolymers. We have also exploited self-assembled synthetic collagen protein and β–peptide fibrils with known molecularly controlled sequences to specifically nucleate and assemble diverse family of inorganic nanocrystals. The organized nanomaterial systems and the understanding in such assembly process